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Histo-morphological and Endoscopic Study of Furstenberg's Rosette in Teats Inlocal Breed of Goat

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ABSTRACT: The teats and the teat canal serves as the first line of defense in protecting the mammary gland against various infections. The present study was undertaken to gain a detailed insight of the teat canal by the histo-logical and gross appearance of appearance of teat canal when seen using the telescope to gain a detailed insight of it. Histologically the smooth muscles were seen getting condense towards the streak canal. The apocrine sweat gland, were observed which the part of excretory duct. The alveolar secretory tissue, were seen present in the wall of the lactiferous sinus which emptied directly into the lumen of the lactiferous sinus. Furstenberg's rosette, which appeared as modified zone of mucosa were thrown into primary and secondary folds, located in between teat canal and teat cistern. Bilayered cuboidal epithelium lined the mucosal folds. Subepithelial area of rosette was formed by of numerous lymphocytes, polymorpho-nuclear leukocytes, macrophages and plasma cells. Stratified squamous keratinized epithelium lined the mucosa below the Furstenberg's rosette. The endoscopic examination of teat which is called as theloscopy showed that the mucosa of the teat duct was smooth bearing a color film from white to black. The area around Furstenberg's rosette appeared as an undulation of the mucosa emerged in the teat cistern having the same color with the teat duct. Whereas the mucosa of the teat cistern was smooth with color varying from white to yellow.

Keywords: theloscopy, polymorpho-nuclear, Subepithelial, endoscop.

INTRODUCTION

In small ruminants, each mammary gland was distally continued by single teat, which was composed of teat cistern teat wall, Furstenberg's rosette and teat canal /streak canal (Atyia, 2009). The tissues that form the teat directly affect the performance of the mammary gland. Its structure determines milking method. Other than mastitis there are some diseases, systemic infections which can affect the mammary gland, which may lead to various conditions which might lead to huge economic loss. Many diagnostic procedures are available for the early detection of disease like mastitis but the methods like endoscopic examination of teat canal which is even called as theloscopy-which is an effective and non-invasive technique, which can be used for diagnosis of teat lesions in dairy cow (Riedl et al., 2004a; 2004b) and dairy ewes by (Kiossis et al., 2009). Although diagnostic use of teat endoscopy in dairy goats has been reported before (Hospes et al., 1997), no detailed accounts exist of lesions observed with using the technique. The principal advantage of the technique is the real-time examination of the inner part of the teat, by means of a non-invasive way. Diagnosis and prognosis of teat lesions are, most of the

times accurate. Teat canal serves as the primary route of entry of ascending infections caused due to microorganisms, leading to mastitis in ruminants. External skin layer and other mucosal tissues are protected by robust defense mechanisms consisting of antimicrobial barriers and an array of epithelialassociated immune cells (Smolenski, 2018). Apart from the natural protective barriers in the teat end such as keratin produced by teat canal epithelium and teat skin, there is a rosette like structure that comprises numerous antibody producing cells and phagocytes to fight entering antigens from the external environment. In between the teat canal and teat cistern Furstenberg's rosette appeared as a modified zone of mucosa thrown into primary and secondary folds. When observed underlow magnification, cross section of the teat sinus in cows revealed that the epithelial folds, covering the closed teat canal resembling the petal like arrangement or rosette of a flower (Smolenski, 2018), who even stated that there was always a Furstenberg's rosette associated lymphoid tissue (FALT) in mammary gland of cow and ultimately antigens are gained in this region. Specific response is formed locally against these antigens and has an important role in mucosal immune defense of teat end (Asti et al., 2011). Furstenberg's

rosette acts less as a mechanical seal of the teat canal and more as a local immune cell defense (Avdic *et al.*, 2015). Research reports on histology, immunohistochemistry of Furstenberg's rosette region in cow was reported by many authors. However the literature about Furstenberg's rosette of small ruminants, that to specifically the histology and theloscopy is scars. This study was done as an aid, to understand the pattern teats and Furstenberg's rosette of and goat is scarce. The present study was undertaken on the 10 local breeds of apparently healthy goat.

MATERIALS AND METHODS

The present research work was carried out on histomorphological and endoscopic study of study of teat in goat (*Capra hircus*). The udder samples were collected from local slaughterhouse and were subjected for endoscopic study first and subsequently tissue samples were collected. Only normal appearing udders were taken into consideration after proper palpation and routine examination. Immediately after that, within three hours of time frame the entire procedure related to endoscopy was performed and the tissue samples were collected for histological examination.

(A) Endoscopy of teat was done through the teat end, teat duct as well as from the teat skin at the base of the teat (Lateral endoscopy) as per the method mentioned by Medl *et al.* (1994) and as modified by Kiossis *et al.* (2002). A rigid endoscope (length: 15 cm, diametre: 2.7 mm) was used. The colour, the shape and the within-teat location of lesions observed were recorded and evaluated. Then the samples were prepared for prepared for histological examination.

(B) Histological study was carried out by collecting the tissue pieces from different regions of the teats which were fixed in 10 % neutral buffered formalin. These tissue pieces were then treated with a routine method of dehydration in ascending grades of alcohol (ethanol), cleared in Xylene/Cedar wood and embedded in paraffin wax as per the method of Singh and Sulochana (1996). The paraffin blocks were sectioned at 3 to 5 micron thickness. The prepared slides were stained with following stains to make the histological observations as described by Singh and Sulochana (1996).

RESULT AND DISCUSSION

From the 10 udders examined, in 01 of the udders under examination, there was presence of extensive areas with hardened parenchyma was felt after palpation, when incision was given on the udder, milk clots and much of reddened parenchyma was observed which might be the alteration caused due to infectious bacteria of mastitis, furthermore the teat endoscopy revealed multiple diaphragms in teat cistern of both teats of each of the above udders.

Observations from the normal teats: The other 09 udders from the ten under study, appeared normal with having the mucosa of the teat duct appearing smooth and white to yellowish in color. In all teats, mucosa in that region had the same color as that of the teat duct. The mucosa of the teat cistern was smooth and, in some

cases, with small folds. Color of the mucosa varied from white to yellowish.

Histological examination revealed that the, wall of teat was made up of three layers from outside to within as, teat skin, middle fibro musculo-vascular layer and innermost teat mucosa. The histo-architecture of these three layers corroborates with the research findings of Turner (1952); Atyia (2009). Teat duct was lined by, stratified squamous epithelium that was transformed into two-cell layer cuboidal epithelium at the teat cistern. However, within the corium increased number of lymphocytes and plasma cells were recorded between teat duct and teat cistern. The most important part of this region was the teat sphincter and the keratin plug. These are one of the most important barriers of protection against microorganisms by avoiding penetration into the udder. Similar findings were recorded by Capuco et al. (1992). It was noticed that, the teat canal/streak canal was lined by a stratified squamous keratinized epithelium and the height of epithelium was seen differing significantly in various stages of lactation. This finding corroborates with the findings (Senthilkumar et al., 2020) who studied the histology of teats of lactating and non-lactating groups in ewes and she-goats. The main reason behind this might be that in lactating animals, more amount of keratin gets synthesized and released by the teat canal between milking which resulted in more height of epithelial layer. Periodic desquamation of the stratum corneum of the lining epithelium of teat canal resulted in the formation of a keratin plug which occluded the lumen of the teat canal between milking. Maior important observations recorded which corroborate with the findings teat had a small cistern terminating at its distal extremity in the streak canal, which was the opening to the exterior of the teat, radiating downward from its internal opening into the streak canal known as the Furstenberg's rosette, which was composed of about seven or eight loose folds of double layered epithelium and underlying connective tissue; each fold had a number of secondary folds. Teat cistern and Furstenberg's rosette were seen to be lined by a two layered cuboidal epithelium. These findings corroborate with the findings of (Reece, 2005). There was presence of compact and dense muscular fibers along the teat duct, coupled with an increased number of relatively large vessels at teat end. This has been considered as the major important component which offers increased resistance to teat injuries compared with large ruminants as stated by (Ludewig, 1998). Smooth muscle fibres were seen arranged circularly around the teat canal constituted the teat sphincter in both lactating and non-lactating animals. The thickness of the teat sphincter was found to be more during lactation. Circular smooth muscle fibres were observed as well.

Comparison of endoscopic and histological findings indicated that sites appearing as red regions macroscopically were hyperemic. The observed hyperemia could be focal or diffused, which might be covering relatively extensive areas, recorded in one sample of udder and the teat. The correlation between results of endoscopy and histological examination indicate that, possibly, yellow color at teat cistern may be a feature of previous hemorrhages in the same location. Such type of hemorrhages, frequently result in deposition of hemosiderin at the corium (Bleul *et al.*, 2000).



Fig. 1. Normal Teat canal.



Fig. 2. Theloscopy being done.



Fig. 3. Furstenberg's rosette, seen through an Endoscope.



Fig. 4.Photomicrograph of area of border of the teat duct and teat cistern (H & E 120 x).

CONCLUSIONS

In the cross sections view of the teat canal, it was seen to be composed of five to seven cornified epithelial projections forming the star shaped slit. Also that keratin content was more in the lumen of non-lactating teat canal as compared with the lactating teat canal. This observation is in accordance with the findings of Ferdowsi *et al.* (2008) in cows. It was noted by Capuco et al. (1992) that in addition to the physical protection, keratin also protects the mammary gland from ascending infections caused bv various microorganisms. Chemically, keratin contains cationic proteins, xanthine oxidase, and long-chain fatty acids which made the keratin as bactericidal or bacteriostatic in function and physically, keratin entraps the bacteria, preventing their entry into the mammary gland, resulting in providing a barrier to prevent occurrence of mastitis in ruminants. From the present study it can be concluded that Keratin present in the teat canal gives the teat ability to prevent passage of bacterial pathogens from the external environment into the mammary gland. The present study even reveals usefulness of teat endoscopy as a diagnostic technique in dairy goats and to investigate the nature and prevalence of teat lesions. The theloscopy can be used for both diagnosis and monitoring of the surgical treatment (Querengasser et al., 1999). The comparative endoscopic and histological study would help in evaluation of diagnostic accuracy of the technique. This would even support hypotheses regarding pathogenesis and prognosis of teat lesions.

FUTURE SCOPE

The present endoscopic technique allowed full exploration of the teat and gland cistern without major interference from descending milk, which is comparable to the results of Shakespeare (1998). Such a comparative study of the teats could potentially help the evaluation of the accuracy of diagnosis set by endoscopy and to seek useful conclusions regarding various infectious agents if any and prognosis of teat lesions in small ruminats.

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